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NEW CRAYFISHES OF THE GENUS *CAMBARUS* FROM  
TENNESSEE AND GEORGIA (DECAPODA, ASTACIDAE)

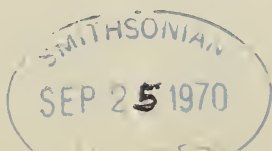
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Of the two species described below, *Cambarus cymatilis* is by far the more esthetically attractive, but the comparative drabness of *Cambarus bouchardi* is compensated for by its possessing certain characteristics which are believed to be primitive and others which seem to link the most primitive member of the genus, *Cambarus pristinus* Hobbs, 1965: 268, with other species groups.

Hobbs (1965: 272) proposed the hypothesis that the genus *Cambarus* had its origin on the Cumberland Plateau because it is the home of not only *C. pristinus*, which is restricted to the Caney Fork of the Cumberland River, but also that of two not too distantly related relict troglobitic subspecies belonging to the genus *Orconectes*. Furthermore, the slightly more advanced *C. obeyensis* Hobbs and Shoup, 1947: 138, occurs on the Plateau in the Obey River drainage, also a tributary of the Cumberland River. The discovery of this third primitive species in headwater streams of the Big South Fork of the Cumberland lends additional evidence to support the conclusion that the Cumberland Plateau, and perhaps the present Cumberland River basin, represents the ancestral home of the genus.

Further importance attaches to this new crayfish in that whereas *C. pristinus* provided evidence of a link between the genera *Procambarus*, *Orconectes*, and *Cambarus*, *C. bouchardi* affords a tie between *C. pristinus* and some of the more advanced subgenera. In fact, as the subgenera are currently defined, this crayfish is not readily assignable to any of them.



Only two characteristics need to be discussed in any detail here. The first pleopod of the male resembles that of *C. pristinus* more closely than that of any other species, and with respect to the terminal elements resembles the troglobitic *Orconectes* even more than does *C. pristinus*, for the two terminals are even less reflected caudally than are those of the latter. The only feature of the pleopod which is distinctly more evolved from the hypothetical Adorconectoid stock (Hobbs, 1969: 119, 121) is the caudal knob which is more strongly developed in *C. pristinus*. The second character is the chela which in *C. bouchardi* is distinctly *Cambarus*-like in contrast to that of *C. pristinus* which is much more like that of the generalized members of the genus *Procambarus*. In the latter species, the chela is elongate, the dorsal surface of the palm is studded with ciliated tubercles, and the row of tubercles on the mesial surface of the palm is not conspicuously larger than those close by. The chela of *C. bouchardi* is subquadrate, resembling most closely those of members of the subgenus *Jugicambarus*, but the highly variable tuberculate condition of the mesial portion of the palm only occasionally consists of a "single cristiform row of tubercles" (Hobbs, loc. cit., p. 106). According to this character some individuals are *Depressicambarus*-like, and others are almost typical of *Puncticambarus* (see Variations following the description of *C. bouchardi* below). Thus, within the variants of the primitive *C. bouchardi* are found certain characteristics typical of three subgenera. Although such an occurrence makes for difficulty in diagnosing the subgenera, from a phylogenetic standpoint the presence of such variability within a species that, for the most part, is otherwise primitive does not weaken the subgeneric (or species group) concept but rather strengthens the probability of their supposed derivations from a common ancestral stock.

In my treatment of the genus *Cambarus* (1969), which was prepared prior to my knowledge of the existence of this crayfish, I gave careful consideration to the subgeneric designation of *C. obeyensis*. This species, except for the first pleopod of the male, seems clearly to have its affinities with those species assigned to the subgenus *Jugicambarus* and is strikingly differ-

ent in a number of features from *C. (Veticambarus) pristinus*. The latter seemed so *Procambarus*-like in its large eyes, broad short areola, and its elongate, tuberculate chela that it was deemed best to emphasize the *Procambarus* traits by isolating it in a monotypic subgenus. With the discovery of *C. bouchardi*, however, there are now three species possessing primitive first pleopods, and two of them exhibiting characteristics diverging from the hypothetical cambaroid ancestor, to some degree, in different directions. Although, perhaps the *Procambarus* features of *C. pristinus* and the *Jugicambarus* traits of *C. obeyensis* will be somewhat obscured, it seems desirable to redefine the subgenus *Veticambarus* to receive the three species.

Subgenus *Veticambarus* Hobbs, 1969; emended

*Cambarus (Veticambarus)* Hobbs, 1969: 96

*Diagnosis:* Eyes moderately large to large and pigmented. Antennae not heavily fringed on mesial border. Rostrum without marginal spines or tubercles, margins not conspicuously thickened. Postorbital and cervical spines small. Suborbital angle acute. Branchiostegal spine small or reduced to tubercle. Areola broad (1.8 to 4.4 times longer than wide), constituting 30.0 to 38.6 percent of entire length of carapace and with few to many shallow punctations. Chela elongate or subquadrate and subovate to moderately depressed in cross section; mesial surface of palm with one or more rows of tubercles, dorsal surface with punctations or squamous tubercles; lateral margin of fixed finger somewhat costate with row of setiferous punctations and sometimes low tubercles basally but never bearing row of spines; fingers not gaping and with well-defined longitudinal ridges dorsally; proximal opposable margin of dactyl never deeply concave; conspicuous tuft of setae never present at mesial base of fixed finger, lateral base never strongly impressed. First form male with coxa of fourth pereopod lacking large ventral setiferous pit on caudo-mesial boss; first pleopods almost contiguous basally; terminal elements consisting of (1) short, bladelike central projection with subterminal notch and recurved at 20 to 60 degrees to shaft; (2) thumblike or tapering mesial process directed caudadistally and somewhat laterally and extending caudad beyond tip of central projection; and sometimes (3) rounded caudal knob at caudolateral base of central projection.

*Type-species:* *Cambarus pristinus* Hobbs, 1965: 268; designated by Hobbs, 1969: 98.

*List of Species:* *Cambarus (Veticambarus) pristinus*, *Cambarus (Veticambarus) bouchardi* new species, and *Cambarus (Veticambarus) obeyensis* Hobbs and Shoup, 1947: 138.

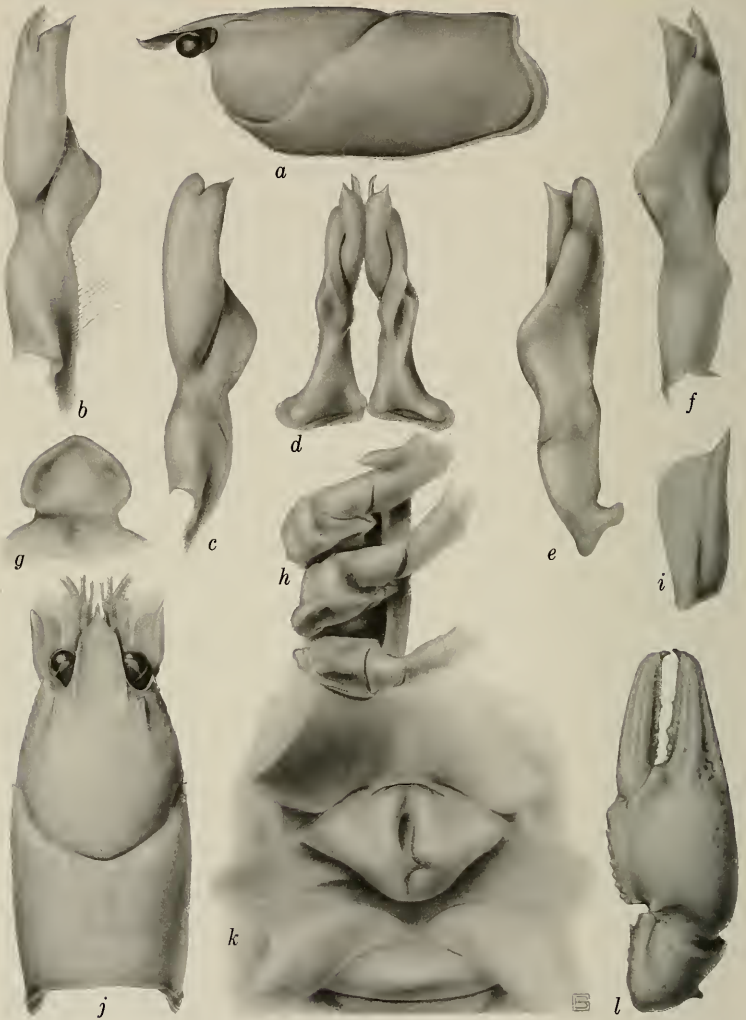


FIG. 1. *Cambarus* (*Veticambarus*) *bouchardi* new species (pubescence removed from all structures illustrated except for b, j, and l). a, Lateral view of carapace of holotype. b, Mesial view of first pleopod of holotype. c, Mesial view of first pleopod of morphotype. d, Caudal view of first pleopods of holotype. e, Lateral view of first pleopod of morphotype. f, Lateral view of first pleopod of holotype. g, Epistome of holotype. h, Proximal podomeres of third, fourth and fifth pereopods of holotype. i, Antennal scale of holotype. j, Dorsal view of carapace

**Cambarus (Veticambarus) bouchardi** new species

*Diagnosis:* Body pigmented, eyes moderately large and well developed. Rostrum with gently convergent margins, lacking marginal spines or tubercles. Areola 2.9 to 4.4 times longer than wide and comprising 31.1 to 38.6 percent of entire length of carapace. Cervical spines moderately prominent and flanked by one or two tubercles caudodorsally. Suborbital angle acute. Postorbital ridges terminating cephalically in short, acute spines. Antennal scale 2.2 to 2.4 times longer than broad, broadest distal to midlength. Chela with one or two (occasionally three) rows of tubercles along mesial surface of palm, mesial row consisting of seven to 10 tubercles; lateral margin of palm rounded, and both fingers with well-defined longitudinal ridges on upper surface. First pleopod of first form male (Fig. 1b, d, f) with short, corneous, bladelike central projection recurved caudolaterally at angle of approximately 20 degrees, inclined slightly laterally, and bearing slight excavation (equivalent to subterminal notch in other species) distally; mesial process non-corneous, bulbous basally, tapering distally, reflected from axis of shaft at angle of approximately 45 degrees, and extending much farther caudolaterally than central projection; distinct prominence at caudolateral base of central projection corresponding to caudal knob in *C. pristinus*. Annulus ventralis (Fig. 1k) rather shallowly embedded in sternum, its marginal contour almost symmetrical, and bearing prominent median longitudinal trough flanked by pair of ridges; caudal portion depressed rather than elevated. Color mottled greenish tan, with banded abdomen.

Holotypic Male, Form I: Body subovate, depressed. Abdomen narrower than thorax (12.3 and 13.4 mm); greatest width of carapace greater than depth at caudodorsal margin of cervical groove (13.4 and 10.0 mm). Areola 3.2 times longer than wide, with scattered punctations, six across narrowest part. Cephalic section of carapace 1.9 times longer than areola (length of areola 34.0 percent of entire length of carapace). Rostrum with very gently convergent margins along basal two-thirds, becoming more sharply so in distal third, forming moderately long, slender acumen, its upturned tip reaching end of antennular peduncle; margins not thickened and devoid of spines or tubercles; upper surface irregular with cephalomedian elevation cephalically (not a carina), median concavity near level of caudal margin of orbit, and with setiferous punctations except in elevated cephalomedian area; subrostral ridges very weak but evident in dorsal view to base of acumen. Postorbital ridges rather short but well-defined, with dorsolateral groove, and terminating cephalically in small acute corneous tubercles. Suborbital angle strong and acute. Branchiostegal spine reduced to rounded tubercle. Carapace

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of holotype. k, Annulus ventralis of allotype. I, Dorsal view of distal podomeres of cheliped of holotype.

TABLE 1. Measurements (mm) of *Cambarus (Veticambarus) bouchardi*.

	Holotype	Allotype	Morphotype
Carapace:			
Height	10.0	12.8	10.7
Width	13.4	16.9	13.7
Length	27.4	33.0	27.5
Areola:			
Width	2.8	3.3	3.1
Length	9.3	11.2	9.6
Rostrum:			
Width	4.2	5.6	4.6
Length	8.0	8.3	6.5
Chela:			
Length of inner margin of palm	7.0	8.3	7.5
Width of palm	8.7	10.2	9.1
Length of outer margin of hand	20.3	24.0	21.3
Length of dactyl	11.4	14.6	11.8

mostly covered with shallow punctations dorsally and dorsolaterally and weakly granulate laterally; granules in hepatic area and linear series below cephalic portion of cervical groove larger than most of those on branchiostegites; gastric area polished. Cervical spines present and flanked dorsally by one or two moderately large tubercles. Abdomen longer than carapace (31.0 and 27.4 mm); pleura moderately short and rounded ventrally but those of second through fourth abdominal segments subangular caudoventrally. Cephalic section of telson with two spines in each caudolateral corner; mesial spines movable. Proximal podomere of uropod with strong medial and weak lateral spines overreaching lateral bases of corresponding rami; mesial ramus with keel on upper surface produced in moderate spine not reaching distal margin of ramus and another moderate spine on distolateral angle; lateral ramus of uropod with transverse row of spines across distal margin of proximal section.

Projecting portion of epistome (Fig. 1g) broadly ovate, approximately 1.3 times broader than long, its margins slightly elevated (ventrally) and little thickened; surface elevated caudomesially and with numerous setiferous punctations, fovea moderately prominent; caudal margin of epistome thickened and broadly arched. Antennules of usual form with small spine at base of distal third of ventral surface of basal podomere. Antenna reaching fifth abdominal tergum. Antennal scale (Fig. 1i) about 2.3 times longer than broad, broadest distal to midlength with widest lamellar area approximately 1.6 times width of thickened lateral portion,

latter terminating in moderately strong spine. Third maxillipeds densely setose and reaching base of distal podomere of antennal peduncle.

Right chela (Fig. 11) not depressed, with subrectangular palm rounded laterally. Mesial surface of palm with three irregular rows of tubercles: mesial row of seven, ventral row of four, and very irregular dorsolateral row of six; remainder of chela punctate except for tubercle on ventral surface at base of dactyl, two or three smaller ones proximal to it, and opposable margins of both fingers. Fingers not gaping, both with well-defined median longitudinal ridges dorsally and ventrally. Opposable margin of fixed finger without tuft of setae proximoventrally but with row of four corneous tubercles along proximal half, third from base largest, and no conspicuous gap between tubercles; fifth tubercle present below level of row at base of distal two-fifths of finger; several rows of minute denticles extending between tubercles and distally to corneous tip of finger. Corresponding margin of dactyl with row of four similar tubercles along proximal three-fifths and with distinct gap between third and fourth (left chela with fourth tubercle closer to third and no conspicuous gap between them); minute denticles arranged as on fixed finger; mesial surface of dactyl with large punctations, one of proximal punctations with single squamous tubercle projecting into proximal border of pit.

Carpus of right cheliped longer than broad with wide oblique furrow dorsally; dorsal surface with five (four on left) small tubercles dorso-mesially, otherwise mostly punctate; mesial surface with one large spike-like tubercle and smaller one proximal to it; ventral surface with usual two tubercles on distal margin and two smaller ones between mesial marginal tubercle and major tubercle on mesial surface.

Merus of right cheliped with two (three on left) spiniform tubercles on upper distal surface; mesial and lateral surfaces sparsely punctate, and ventral surface with lateral row of three (left with four) spikelike tubercles and mesial row of eight. Mesial surface of ischium with row of three small tubercles and proximal knoblike tubercle.

Hooks on ischia of third pereopods only (Fig. 1h); hooks simple, not opposed by tubercle on basis, but extending proximal of distal end of latter. Coxa of fourth pereopod with single large obliquely vertical prominence (boss) caudomesially; coxa of fifth pereopod without prominences.

Sternum moderately shallow between third, fourth, and fifth pereopods and with tufts of plumose setae extending ventromesially from margins of sternum and coxae.

First pleopods (Fig. 1b, d, f) symmetrical and reaching coxa of third pereopod when abdomen is flexed. (See diagnosis for description.)

Allotypic Female: Differs from holotype in following respects: cephalomedian portion of upper surface of rostrum plane; branchiostegal spines small but acute; projecting portion of epistome with margins more thickened and elevated ventrally; mesial surface of palm of left chela

(right regenerated) with two tubercles below proximal end of mesial row of tubercles and irregular row of four above distal end; opposable margin of fixed finger with row of five tubercles and that of dactyl with row of six, tubercles below and distal to row on fixed finger absent; lower surface of carpus with group of three tubercles between mesiodistal tubercle and major tubercle on mesial surface; lower surface of merus with lateral row of five tubercles and mesial one of nine with two smaller tubercles near lateral margin of latter row; sternum between bases of third through fifth pereopods and coxae of pereopods without conspicuously long tufts of setae.

Annulus ventralis (Fig. 1k) not deeply embedded in sternum but firmly fused with sternal plate immediately cephalic to it; cephalic portion superficially, at least, as heavily sclerotized as caudal portion, but entire annulus movable. Cephalic portion with median longitudinal trough flanked by comparatively low ridges; caudal two-thirds of floor of trough weakly sclerotized; sinus originating on sinistral side of caudal end of trough, curving sinistrally for short distance before turning caudodextrally to median line, from there extending caudally on caudal shelflike portion of annulus to caudal margin. Median sternite between fifth pereopods somewhat spindle-shaped in outline with transverse ventral elevation reaching peak at middle of sclerite. First pleopod uniramous and reaching midlength of annulus when abdomen is flexed.

Morphotypic Male, Form II: Differs from holotype in following respects: upper surface of rostrum more nearly concave throughout its length; subrostral ridges evident in dorsal aspect for only approximately half length of rostrum; branchiostegal spines small but acute; cervical spines very small and flanking tubercles weak; pleura of abdomen more rounded; mesial surface of palm of right chela (left regenerated) with mesial row of eight tubercles and irregular rows of five below and three above it; opposable margin of fixed finger with row of three tubercles and more distal tubercle below level of row; lower surface of merus with lateral row of four tubercles; ischium with row of four; hooks on ischia of third pereopods reduced and not reaching distal margin of basis; protuberances on coxae of fourth pereopods only little less conspicuous than those on holotype.

First pleopod (Fig. 1c, e) with neither terminal element corneous; central projection inflated and only slightly curved caudodistally; mesial process reduced but constructed and disposed essentially as in holotype; prominence at caudolateral base of central projection and oblique suture on shaft very prominent.

*Type-locality:* Perkins Creek, 6.9 miles north of Oneida, Scott County, Tennessee on U. S. Hwy. 27. This stream is a tributary of the Big South Fork of the Cumberland River, and on 6 April 1969, when I collected in this locality, the stream was flooded, and the current of cloudy water was so swift that it was difficult to maintain a firm footing on the rocky stream bed. On this occasion, the creek was 25 to 50 feet in width and



had a maximum depth of two feet in the areas seined. There were no aquatic plants but *Tsuga*, *Alnus*, and *Rhododendron* thickets flanked the water line, and *Pinus* and *Quercus* were growing on the banks.

*Disposition of Types:* The holotypic male, form I, the allotypic female, and morphotypic male, form II, are deposited in the Smithsonian Institution (nos. 130295, 130296, and 130297, respectively) as are the following paratypes: 4 ♂, form I; 20 ♂, form II; 31 ♀; 8 juvenile ♂; and 9 juvenile ♀. The remaining paratypes (11 ♂, form I; 5 ♂, form II; 11 ♀; 8 juvenile ♂; and 1 juvenile ♀) are in the collection of Raymond W. Bouchard.

*Size:* The largest male, form I, has a carapace length of 37.5 mm, the largest female, 38.4, and the smallest first form male, 25.7 mm.

*Color Notes:* All of the adult specimens collected in April were encrusted with a black coating, and few observations could be made on the color pattern. A second form male was brought into the laboratory and molted to first form in August. The following observations were made on this specimen within a few days following its molt.

Ground color of carapace greenish tan mottled with cream tan and brown; branchiostegites with longitudinal subtriangular bars extending cephalically from caudal margin to cervical groove; hepatic region with similarly colored bar contiguous with caudolateral irregular splotches on surface of origins of mandibular muscles; gastric region mostly orange-tan although mottled with paler markings; ventrolateral portions of carapace fading to tannish cream. Abdomen pale olive, speckled with brown and with two distinct pairs of scalloped longitudinal brown bands: broader dorsolateral ones extending from base of abdomen to midlength of sixth abdominal tergum; lateral band extending along bases of pleura to spine on base of uropod; first abdominal segment with pair of conspicuous cream spots between just-mentioned rows. Cervical spines cream. Eyes with narrow cream band bordering faceted region. Chela brown with dark brown mottlings; tubercles pale, especially major ones on opposable margin of fixed finger; both fingers with scarlet tips; carpus and distal portion of merus also dark brown with all major tubercles cream; proximal portion of merus and remaining basal podomeres cream, similar to those of other pereiopods; second through fifth pereiopods with upper surface of distal portion of merus to extremity of appendages mottled greenish cream; lower surfaces of all pereiopods pale tan to cream. Antennae and outer ramus of antennule ringed with dark greenish brown; inner ramus of antennule lighter in color; basal podomeres of both appendages mottled cream and dark brown; antennal scale with dark greenish tan borders and cream lamellar area. Ventral surfaces of gnathal appendages mostly cream but articular areas of third maxilliped pinkish.

*Range:* *Cambarus bouchardi* is known from only three localities in the Big South Fork of the Cumberland River: the type locality; Roaring Paunch Creek, approximately 8.5 miles north of Oneida, Scott County, Tennessee on U. S. Hwy. 27; and the latter creek at County Rte. 2449.

*Variations:* The range of variation in specimens from these localities

does not seem to differ appreciably. Most conspicuous among the variations are those of the chela. Whereas in general shape it is usually subquadrate, resembling that typical of most members of the subgenus *Jugicambarus*, the variations in the armature of the mesial surface of the palm is equal to, or exceeds, that of any species of the genus. In some individuals, it consists of a single subcristiform row of tubercles with scarcely a trace of tubercles above or below the row; in others, a few tubercles may flank such a row on both sides; in yet other specimens, there are three distinct rows, and finally, the tubercles are so irregularly situated that it is difficult to perceive a linear arrangement. The rostrum, too, is somewhat variable in the relative thickness of the margins and in their cephalic convergence; in some specimens, the margins are distinctly more thickened than they are in the holotype but hardly approach the thickened conditions observed in many other members of the genus, and the borders extending onto the acumen may narrow imperceptibly or rather suddenly. The cervical spines, nearly always small in larger specimens, are occasionally reduced to spiniform tubercles. Variations in the first pleopod of the first form male include a slight flaring of the terminal portion of the central projection in some specimens, and much more variation in the distal portion of the mesial process. In some individuals, the latter is more attenuate than that illustrated (Fig. 1b, d, f), and its distalmost portion is curved somewhat mesially. In the dextral pleopod of one of the males from Roaring Paunch Creek, the process is broadly rounded distally, lacking the tapering distal portion which is otherwise characteristic of the species. The annulus ventralis varies chiefly in the degree of sclerotization of the cephalic portion, but it is never membranous as in such species as *C. cymatilis* (see below). Ratios of variations of the length of the areola to that of the carapace are shown in Figure 2.

*Relationships:* *Cambarus bouchardi*, as was pointed out in the introductory remarks, has its closest affinities with *Cambarus pristinus* and *C. obeyensis* from which it may be distinguished by the more nearly distally directed terminal elements of the first pleopod of the male. *Cambarus pristinus* has a broader, and usually shorter areola, 1.8 to 2.3 times longer than broad and constituting only 30.0 to 33.3 percent of the total length of the carapace, whereas, the corresponding measurements in *C. bouchardi* are 2.8 to 4.4 and 31.1 to 38.6 percent (lower percentages generally in small or juvenile specimens), and in *C. obeyensis* 3.3 to 4.4 and 33.5 to 37.6. The chela of *C. pristinus* is also elongate and the upper surface of the palm covered with squamous tubercles while that of *C. bouchardi* and *C. obeyensis* are subquadrate, and tubercles on the palm are limited to the mesial portion. Thus, there are several characters which distinguish *C. bouchardi* from *C. pristinus*; while there are fewer which separate it from *C. obeyensis*, the first pleopods are distinct and generally there are fewer tubercle rows on the mesial surface of the palm of the chela in *C. obeyensis*. In neither the latter species nor in *C. bouchardi* is

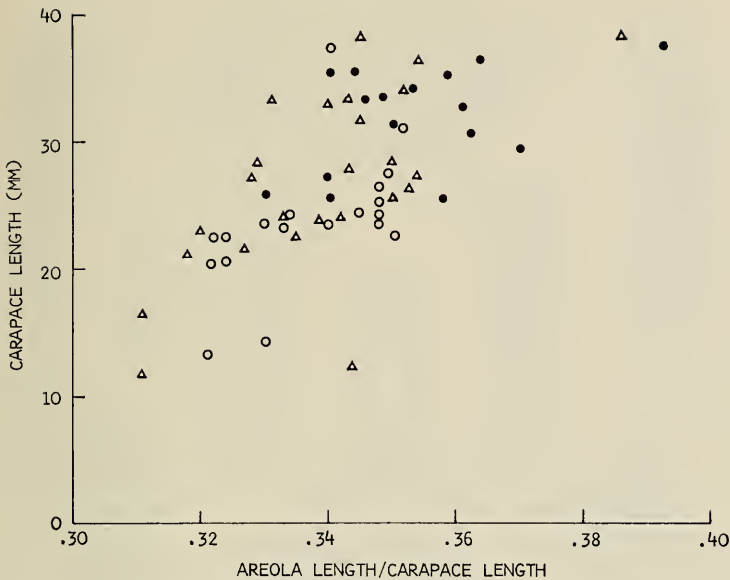


FIG. 2. Relationship of relative length of areola to carapace length in *Cambarus (Veticambarus) bouchardi*. Triangles signify females; solid circles, first form males; and open circles, second form males.

the caudal knob of the pleopod nearly so well developed as it is in *C. pristinus*.

*Life History Notes:* The available specimens were collected on 26 May 1968, 17 and 22 September 1968, and 6 April 1969. First form males were present in the collections made in September and April; none of the females was carrying eggs or young.

*Etymology:* This crayfish is named in honor of its discoverer, Mr. Raymond W. Bouchard, who has added much to our knowledge of the crayfishes of Tennessee.

#### ***Cambarus (Depressicambarus) cymatilis* new species**

*Diagnosis:* Body pigmented, eyes small but well-developed. Rostrum concave with convergent margins, and lacking marginal spines or tubercles. Areola very narrow or obliterated, at least almost linear at mid-length, and comprising 41.7 to 44.8 percent of entire length of carapace. Cervical spines or tubercles lacking. Suborbital angle acute. Postorbital ridges terminating cephalically without tubercles or spines. Antennal scale 2.4 to 2.8 times longer than broad, broadest distal to midlength. Chela with two rows of tubercles on mesial surface of palm, mesial row consisting of six to eight; lateral margin of chela costate, and both fin-



FIG. 3. *Cambarus (Depressicambarus) cymatilis* new species (pubescence removed from all structures illustrated except for b and l). a, Lateral view of carapace of holotype. b, Mesial view of first pleopod of holotype. c, Mesial view of first pleopod of morphotype. d, Caudal view of first pleopods of holotype. e, Lateral view of first pleopod of morphotype. f, Antennal scale of holotype. g, Lateral view of first pleopod of holotype. h, Epistome of holotype. i, Proximal podomeres of third, fourth, and fifth pereopods of holotype. j, Dorsal view of cara-

TABLE 2. Measurements (mm) of *Cambarus* (*Depressicambarus*) *cymatilis*.

	Holotype	Allotype	Morphotype
Carapace:			
Height	12.9	16.0	9.9
Width	15.6	19.5	12.9
Length	31.0	39.7	26.2
Areola:			
Width	0.1	0.2	0.0
Length	13.5	17.8	11.4
Rostrum:			
Width	4.6	5.4	4.0
Length	5.1	6.1	4.6
Chela:			
Length of inner margin of palm	7.5	8.4	6.3
Width of palm	11.5	13.4	9.4
Length of outer margin of hand	22.3	26.2	19.2
Length of dactyl	14.3	17.7	12.2

gers with well-defined longitudinal ridge on upper surface. First pleopod of first form male (Fig. 3b, d, g) with comparatively short, corneous central projection recurved at angle of approximately 110 degrees, slightly tapering and with distinct subterminal notch; mesial process non-corneous, sub-conical, and extending caudally beyond tip of central projection. Annulus ventralis (Fig. 3k) deeply embedded in sternum, markedly asymmetrical with strongly caudally deflexed ridge disappearing beneath opposite elevated and inflated wall. Color blue.

Holotypic Male, Form I: Body subcylindrical. Abdomen narrower than thorax (11.0 and 15.6 mm); greatest width of carapace greater than depth at caudodorsal margin of cervical groove (15.6 and 12.9 mm). Areola sublinear at midlength with room for no more than one punctation in narrowest part. Cephalic section of carapace 1.3 times longer than areola (length of areola 43.5 percent of entire length of carapace). Rostrum with gently convergent margins along basal four-fifths, becoming sharply convergent in distal fifth forming short triangular acumen reaching midlength of penultimate podomere of antennule; margins not thickened and devoid of spines or tubercles; upper surface concave

←

pace of holotype. k, Annulus ventralis of allotype. l, Dorsal view of distal podomeres of cheliped of holotype.

with submarginal row of small punctations and with sublinear transverse rows of punctations basally, basal portion with shallow median longitudinal trough extending caudally, broadening and disappearing at level of caudal extremities of postorbital ridges; subrostral ridges comparatively weak but evident in dorsal view almost to base of acumen. Postorbital ridges weak, with dorsolateral groove, and merging with carapace cephalically, lacking spines or tubercles. Suborbital angle strong and acute. Branchiostegal spine obsolete. Carapace mostly evenly punctate dorsally and weakly granulate laterally; granules in hepatic area and linear series below cephalic portion of cervical groove slightly larger than those on branchiostegites; gastric area not polished. Cervical spines or tubercles lacking. Abdomen shorter than carapace (27.0 and 31.0 mm); pleura short and rounded ventrally. Cephalic section of telson with one fixed spine in each caudolateral corner. Proximal podomere of uropod with one strong spine over-reaching lateral portion of mesial ramus; latter with median keel on upper surface produced in strong spine extending much beyond distal margin and additional prominent spine on distolateral angle; lateral ramus of uropod with transverse row of spines across distal margin of proximal section (in some specimens lateral and median spine distinctly larger than others).

Projecting portion of epistome (Fig. 3h) narrow, its width and length subequal, its margins elevated (ventrally) and thickened; except for thickened margins, covered with very fine setiferous punctations; fovea present; caudal margin of epistome much thickened and broadly triangular. Antennules of usual form with small spine at base of distal fourth of basal podomere. Antenna broken but probably reaching sixth abdominal tergum. Antennal scale (Fig. 3f) about 2.6 times longer than broad, broadest distal to midlength with widest lamellar area approximately 1.5 times width of thickened lateral portion, latter terminating in moderately strong spine. Third maxillipeds densely setose and almost reaching distal podomere of antennal peduncle.

Right chela (Fig. 3l) depressed but with palm slightly inflated, lateral margin costate, costa almost reaching base of palm. Mesial surface of palm with two rows of tubercles, more mesial one of eight and adjacent one of six; smaller scattered tubercles present immediately dorsolateral to these rows and extending laterally slightly beyond line joining proximal and distal articular condyles; remainder of chela, except proximomesial surface of dactyl and opposable margins of both fingers, punctate. Lower surface of propodus with one prominent tubercle adjacent to base of dactyl and three smaller tubercles proximal to it. Fingers gaping, both with well-defined median longitudinal ridges dorsally and ventrally. Opposable margin of fixed finger with inconspicuous tufts of setae proximoventrally and with row of four tubercles along proximal three-fifths, third from base distinctly largest, broad gap between it and second tubercle; fifth tubercle present below level of row at base of distal fourth of finger; row of minute denticles extending from distal base of third

tubercle (interrupted by fourth) to base of corneous tip of finger; corresponding margin of dactyl with row of six tubercles along basal two-thirds, second from base largest; row of minute denticles extending from base of distalmost tubercle to corneous tip of finger; mesial surface of dactyl with two rows of six tubercles each along basal half, distal half punctate.

Carpus of right cheliped longer than broad with deep longitudinal furrow dorsally; dorsal surface with few tubercles mesially but mostly with large deep punctations; mesial surface with two large subspini-form tubercles, distal one distinctly larger; ventral surface with two large tubercles on distal margin; another large tubercle, flanked by two or three much small ones dorsomesially, proximomesial to mesial marginal tubercle.

Merus of right cheliped without dorsal spine; mesial and dorsal surfaces scabrous, lateral punctate, and ventral surface with mesial row of 12 tubercles and lateral one of three (10 and two, respectively, on left merus). Row of three smaller tubercles on ischium corresponding to mesial row on merus.

Hooks on ischia of third pereopods only (Fig. 1i); hooks simple, not opposed by tubercle on basis, but extending proximad of distal end of latter. Coxa of fourth pereopod with two prominent, mesially situated protuberances; coxa of fifth pereopod without prominences.

Sternum between third, fourth, and fifth pereopods, deep, and with prominent tufts of plumose setae extending ventromesially from margins of sternum and coxae of third and fourth pereopods, that of fifth with only few setae.

First pleopods (Fig. 3b, d, g) symmetrical and reaching coxa of third pereopods when abdomen is flexed (See diagnosis for description).

Allotypic Female: Differs from holotype in following respects: margins of rostrum, while convergent, slightly concave, acumen longer and with corneous, distinctly up-turned tip; granules on hepatic areas of carapace similar in size to those on branchiostegites immediately caudal to cervical groove; third maxillipeds reaching distal podomere of antennal peduncle; mesial margin of palm of right chela with inner row of seven tubercles and adjacent row with three (six and five, respectively, on left chela); ventral surface of propodus of chela with four tubercles on right (one on left) in addition to spine adjacent to base of dactyl; opposable margin of fixed finger of right chela with third tubercle from base much reduced (left with only four tubercles, but third as in holotype); ventral base of finger with conspicuous tuft of plumose setae; upper distal surface of merus with single acute tubercle; lower surface with mesial row of 10 tubercles and lateral row of five on right chela and six on left; sternum between third and fourth pereopods without tufts of setae.

Annulus ventralis (Fig. 3k) deeply embedded in sternum and firmly fused with sternal plate immediately cephalic to it; cephalic portion not heavily calcified and, therefore, flexible. Flexible portion with median

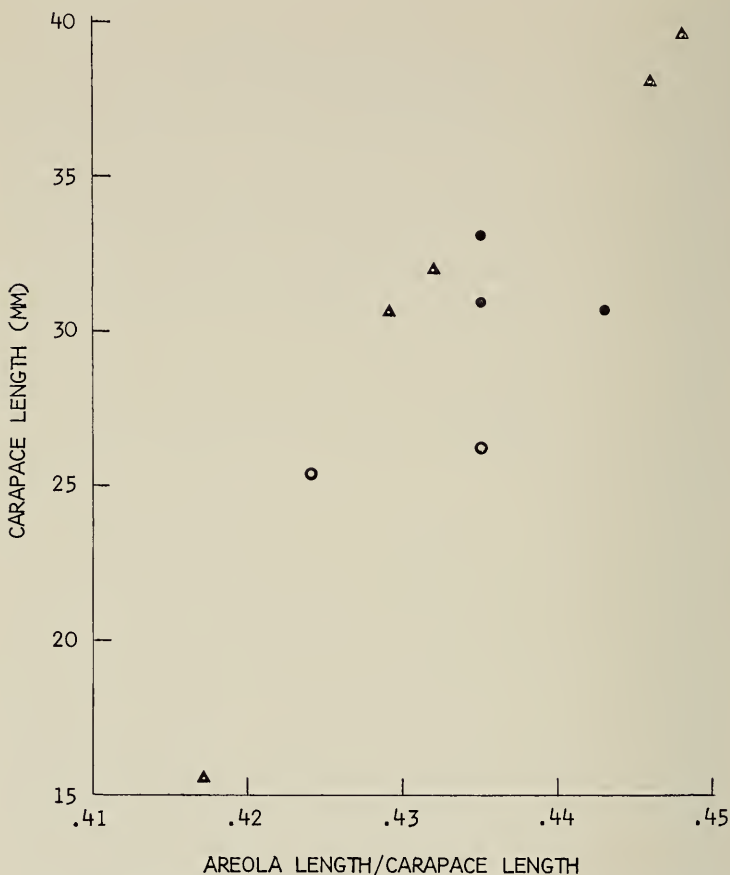


FIG. 4. Relationship of relative length of areola to carapace length in *Cambarus* (*Depressicambarus*) *cymatilis*. Triangles signify females; solid circles, first form males; and open circles, second form males.

longitudinal trough broadening caudally in deep depression flanked by V-shaped, heavily calcified portion; sinistral arm of V produced mesially as tongue dipping below thickened dextral wall; sinus originating in depression dextral to median line, extending caudosinistrally slightly sinistral to median line before turning caudodextrad, cleaving midcaudal margin of annulus. Median sternite between fifth pereopods subovate with gentle transverse elevation at midlength. First pleopod uniramous and reduced in size but reaching caudal margin of annulus when abdomen is flexed.



Morphotypic Male, Form II: Differs from holotype in following minor respects: third maxillipeds extending forward to base of ultimate podomere of antennal peduncle; mesial margin of palm of chela with six tubercles in each row and no tubercles on dorsal surface lateral to two rows; ventral surface with only two tubercles proximal to tubercle at base of dactyl; opposable margin of fixed finger with dense tuft of setae proximoventrally; corresponding margin of dactyl with third tubercle from base largest; upper distal surface of merus of right cheliped with small tubercle, ventral surface of both right and left with lateral row of four tubercles and mesial one of nine; hooks on ischia of third pereopods reduced, not reaching distal end of corresponding basis; caudal protuberance on coxa of fourth pereopod reduced in size.

First pleopod (Fig. 3c, e) with neither terminal element corneous, both bent caudally at approximately 95 to 100 degrees; central projection lacking subterminal cleft, and mesial process projecting only slightly beyond and lateral to central projection.

*Type-locality:* In burrows near the western city limits of Chatsworth, Murray County, Georgia, in lawn and rose garden of Mr. Charles S. Dunn, off Chestnut Street. There the water table was only six inches below the surface, and the specimens were extracted from the burrows with considerable ease. The burrows of the males were simple with only a single opening; those of the females were more complex, all possessing at least two crudely formed chimneys.

*Disposition of Types:* The holotypic male, form I, the allotype, and the morphotypic male, form II are deposited in the Smithsonian Institution (nos. 129860, 129861, and 129862, respectively) as are the paratypes, which consist of 2 ♂, form I; 1 ♂, form II; 4 ♀ and 1 juvenile ♀.

*Size:* The largest male, form I, has a carapace length of 33.3 mm, the largest female, 39.7 mm, and the smallest first form male, 30.7 mm. All of the specimens were collected within two miles of the type-locality. The largest specimen available is the allotype.

*Color Notes:* Dorsal surface of carapace and abdomen dark cobalt blue, fading rapidly on lateral surfaces of hepatic area, branchiostegites, and pleura through pale blue to cream with a faint bluish suffusion. Cephalic section of telson mottled with blue laterally and dark blue triangular area medially, caudal section pale bluish gray. Uropod also pale bluish gray with median longitudinal dark blue line in each ramus, lateral ramus with additional dark blue line along proximal margin of transverse suture. Dorsal surface of peduncle of antenna and lateral margin of antennal scale dark blue. Cheliped dark blue dorsally from distal third of merus almost to ends of fingers; lateral margin of propodus, distal portions of tubercles and fingers, and ventral surface pale gray to bluish cream; tips of fingers corneous (yellow or orange). Dorsal portions of remaining pereopods from merus to propodus mottled with dark blue, otherwise cream to pale grayish blue. Sternal area mostly cream to white with isolated blue patches.

*Range:* This new crayfish is known from only three localities in the immediate vicinity of Chatsworth: the type-locality; 214 Fourth Avenue, in Chatsworth; and in a field adjacent to Holly Creek, 1 mile northeast of Chatsworth.

*Variations:* Among the few available specimens, none of the variations noted differ appreciably from those pointed out in the allotype and morphotype. Mirrored images of the annulus ventralis described for the allotype occur among the paratypic females, and there is evidence that the length of the areola in both male and females increases proportionately with increase in carapace length. (See Fig. 4).

*Relationships:* *Cambarus cymatilis* has its closest affinities with *Cambarus striatus* Hay, 1902: 437, and *Cambarus sphenoides* Hobbs, 1968: 262, but may be distinguished from both by the blue coloration. It also differs from the former in possessing a subterminal notch on the central projection of the first pleopod of the male, and from the latter in possessing a sublinear areola and a conical mesial process on the first pleopod of the male.

Should one attempt to assign this species to one of the subgenera by use of Hobbs' key (1969: 95), he would have difficulty upon reaching "couplet 5," for there are eight tubercles in the mesial row on the palm of the chela in some of the available specimens. Thus far, I have been unable to discover a quantitative character to alleviate the difficulty; consequently, for lack of a better distinction, perhaps the following modification of the couplet may be helpful.

5. Chela elongate; mesial surface of palm with row of 8 or more tubercles ..... 6  
 Chela broadly triangular; mesial surface of palm with row of no more than 8 tubercles, usually fewer ..... 8

The broad palm with two rows of tubercles along the mesial margin and additional tubercles dorsolaterally seems definitely to associate *C. cymatilis* with members of the subgenus *Depressicambarus*.

In distinguishing it from other members of the subgenus, the narrow areola and well-developed suborbital angle will ally this crayfish with *C. sphenoides* in the second couplet of the key (loc. cit., p. 104). It may, however, be distinguished from the latter by the characters cited above.

*Life History Notes:* All of the specimens were collected in April, among them three first form males, two second form males, six females, and a juvenile female.

*Etymology:* *Cymatilis*, L.—sea-colored, blue; so named because of the blue coloration typical of all the specimens examined.

*Acknowledgments:* Mr. Raymond W. Bouchard asked me to examine the first specimens of *C. (V.) bouchardi* that I had seen, and I erred in identifying them as *Cambarus obeyensis*. Later, I collected the species in two localities, one of which proved to be the same as that previously visited by Mr. Bouchard. Only then did I recognize it as distinct from *C. obeyensis*. I am most grateful to Mr. Bouchard for permitting me to

describe the species which is named in his honor. For assistance in collecting the specimens on which the above descriptions are based, I wish to thank Raymond W. Bouchard, Edward T. Hall, Jr., Daniel J. Peters, and Jean E. Pugh. For the excellent illustrations, I am indebted to Carolyn B. Gast. Appreciation is also expressed to Fenner A. Chace, Jr., Marian H. Pettibone, and Joseph F. Fitzpatrick, Jr. for their criticisms of the manuscript.

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